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(54) **Smoking of film packaged food and packaging film used for this purpose.**

(57) A food-packaging film is formed of a polymer component comprising a polyamide resin, optionally blended with an olefin polymer, with 2 to 20% of an additive which is compatible with the polymer component, is liquid at 70 to 95°C and is soluble in water and/or oil. Food can be packaged in this film and smoked and subsequent steam-heating of the package causes the film to acquire good gas-barrier properties.

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Smokable Food-Packaging Film

The present invention relates to a smokable food-packaging film which permits smoking of food packed in it, as a result of permeation of smoke through the film, and yet which can provide excellent gas barrier properties after the smoking treatment.

It is well known to smoke foodstuffs, such as processed meat, while they are packaged within a film, for instance to regulate and maintain the shape of the foodstuff. The film has to be sufficiently permeable to the smoking ingredients to permit them to permeate quickly through the film and into the packaged food. Typical films for this purpose include the entrails of certain animals such as cattle, swine and sheep, as well as cellulosic films made from viscose.

These smoke-permeable films have traditionally lacked the gas barrier properties that are required for long term food preservation and so when this is required it has been customary to package the food in a primary packaging, that is permeable to the smoke ingredients but that is inadequate for long term preservation, and a secondary packaging that provides good gas barrier properties for long term storage.

As the smokable primary packaging material, there have been proposed natural high polymers such as collagen, chitin, polysaccharide, etc., paper impregnated with polyvinyl alcohol resin (Japanese Patent Publication No.47-43198 (1972)), paper impregnated wityh ethylene-vinyl alcohol copolymer containing a plasticiser (Japanese Patent Application Laid Open (Kokai) No.52-57347 (1977)), and polyalkylene oxide-containing copolymer polyester film (Japanese Patent Publication No.59-17530 (1984)). It is also known (GB 1,397,472) to use films that have been perforated or otherwise mechanically made porous so as to improve smokability.

To provide long term storage, all such films have to be used in combination with a secondary packaging material that has the necessary gas barrier properties. This incurs the disadvantage of requiring the supply of a second film and the involvement of additional production steps and an additional packaging machine.

It would therefore be desirable to provide a single film that has satisfactory smoke permeability properties but which will also provide long term gas-barrier properties after smoking.

It is proposed in EP 0139888A1 that a film that provides both smoke permeability and oxygen-barrier properties can be formed from a polyamide or a blend of the polyamide and an ionomer resin, a modified ethylene vinyl acetate copolymer or a modified polyolefin. In particular it is suggested that films comprising polyamides capable of absorbing water in an amount of at least 3% of their own weight of water up to saturation point, such as polycaprolactam, polyaminoenathic acid amide, polyhexamethyladipamide, polyhexamethylenesebacic acid amide, etc., and blend polymers of these polyamides and ionomer resins, modified ethylene-vinyl acetate copolymer and/or modified polyolefins would be useful as smokable thermoplastic synthetic casings. However the only specific description in EP 0139888 is of colourless transparent shrinkable stretched casings made from polycaprolactam or polyhexamethyleneadipamide and these particular films have proved to have inadequate oxygen gas-barrier properties for the long term storage of foodstuffs which are susceptible to oxygen.

Another smokable film that also has inadequate oxygen gas-barrier properties for long term storage of foodstuffs is described in Japanese application Kokai 60-180832 (1985) and comprises at least one layer of a polyamide resin having a water absorption of not less than 5%, an oxygen-permeability of 50 to 300 cc/m^2.day.atm (at 30°C and 60% Relative Humidity (RH) and a thickness of 5 to 50 μm.

Accordingly there is still a need for a smokable food-packaging film (i.e., a film that permits smoking of food that is packed within it) but which gives improved oxygen gas-barrier properties.

A smokable food-packaging film according to the invention is formed of the composition comprising a polymer component comprising 30 to 100% by weight of a polyamide resin and 0 to 70% by weight of an olefin polymer and is characterised in that the composition comprises 80 to 98% of the polymer component and 2 to 20% by weight of an additive which is compatible with the polymer component and is liquid at 70 to 95°C and is soluble in water and/or oil.

We have found that such films can easily be formulated so that they have smokability, i.e., permeability to smoking ingredients, such that foods can easily be smoked while packed within them and yet which can provide suitable gas-barrier properties after smoking. For instance the permeability before and during smoking can be similar to the permeability of collagen films, but the permeability to oxygen after smoking can be very good, in contrast to collagen and other smokable primary packaging films.

The polymer component is preferably selected such that the corresponding film made from the component without the additive (referred to below as the non-additive film) has oxygen-permeability 30°C and 80% RH of not more than 200 cc/m².day.atm, preferably not more than 100 cc/m².day.atm, more preferably not more than 50 cc/m².day.atm.

Permeability values of above 200 cc/m².day.atm are satisfactory, without the need for a secondary packaging, for many foods but for foods that are particularly susceptible to oxygen the polymer component should be selected such that the permeability is less, and is preferably not more than 50 cc/m².day.atm. For instance foods that are very susceptible to oxygen, for instance causing discolouration of myoglobin, e.g., pasty meat products, can satisfactorily be packaged in such films without causing discolouration on long-term storage but they can, nevertheless, initially be smoked.

The polymer component of the present invention is composed of a polyamide resin alone or a mixture comprising not less than 30% by weight, preferably 50 to 95% by weight, more preferably 60 to 80% by weight of a polyamide resin and not more than 70% by weight, preferably 5 to 50% by weight, more preferably 20 to 40% by weight of an olefin polymer. Suitable polyamide resins include nylon 6, nylon 7, nylon 8, nylon 11, nylon 12, nylon 6-6, nylon 6-10, mixtures thereof, and copolymers of the monomers from which these are made.

The olefin polymer is preferably a polyolefin and or a copolymer of an alpha olefin with vinyl alcohol. Copolymers of an olefin with (meth) acrylic acid or alkyl (meth) acrylate or vinyl acetate can be used. In particular suitable olefin polymers include polyethylene, polypropylene, ionomer resins, ethylene-vinyl acetate copolymer, ethylene-ethyl acrylate copolymer, ethylene-acrylic acid copolymer, ethylene-methyl acrylate copolymer, ethylene-methyl methacrylate copolymer, and ethylene-methacrylic acid copolymers. Examples of suitable alpha-olefin and vinyl alcohol copolymers are ethylene-vinyl alcohol copolymer, propylene-vinyl alcohol copolymer, and butene-1-vinyl alcohol copolymer.

The additives that are included with the polymer component must be compatible with the polymer component and must be liquid at a temperature in the range 70 to 95°C and which is the steam heating temperature to which the packaged material is subjected after smoking. The amount of the additives is preferably 5 to 10% by weight. Suitable additives include aliphatic alcohols having not less than 10 carbon atoms; polyglycols such as glycerol, ethylene glycol and propylene glycol; polyoxyethylene sorbitan fatty acid esters; polyhydric alcohol esters such as glycerol monooleate, glycerol monostearate, glycerol triacetate, glycerol tripropionate, glycerol tributylate, glycerol tripentanoate, triethylene glycol dicaprylate, triethylene glycol dicaprylate, and 2,2,4-trimethyl-1,3-pentanediol-di-i-butylate; alkyl esters of aliphatic dibasic acids such as adipic acid, sebacic acid and azelaic acid; alkyl esters of polyvalent hydroxycarboxylic acids such as tartaric acid, acetylcitric acid and citric acid; alkyl esters of aliphatic acids such as acetylricinolic acid, palmitic acid, stearic acid and oleic acid; and epoxy plasticisers such as epoxidised soybean oil, epoxidised castor oil, epoxidised linseed oil, epoxidised sunflower oil, epoxidised linseed oil fatty acid butyl and octyl epoxystearate.

The film preferably has a thickness of 15 to 100, preferably 20 to 60, μm. It is preferably made by a conventional melt moulding method and can be provided and used either in unstretched or stretched (i.e., non-shrinkable or shrinkable) form, according to the intended use. If it is to be provided in shrinkable form then the melt moulded film should be stretched in conventional manner.

The preferred way of utilising the film is to package in the film in the conventional way the food that is to be smoked, and then subject the packaged food to the smoking ingredients in a suitable smoking machine, generally at a temperature of 40 to 80°C for a time of several minutes to several hours, depending upon the type of food, and then steam-heating the package generally at a temperature of 70 to 95°C, preferably 80 to 90°C.

The described additives in the polymer blend permit the smoking components that are generated on heating suitable smoking material during the smoking treatment to permeate through the film and into the packaged food to impart the desired smoking smell and taste to the food. Thus before and during the smoking treatment the film has substantially no gas-barrier properties and allows easy passage of the smoke components through the film.

However during the subsequent heating the defined additives are caused to migrate to the outside of the film and/or into the packaged foodstuff and as a result of this migration the film acquires oxygen gas-barrier properties that are substantially the same as those of the corresponding non-additive film, i.e., the corresponding film made from the polymer component in the absence of the additives. Thus in the invention the film after heat treatment subsequent to smoking preferably has oxygen gas barrier properties of not more than 200, preferably not more than 100 and most preferably not more than 50, cc/m².day.atm.

The foodstuffs that can be packaged with the film include those which need smoking and high preservability, for example, liv stock products such as ham, sausage, bacon and meat, dairy products such as cheese, processed marine products such as various kinds of fishes and shellfishes, and egg products.

The smokable packaging film of the pr sent invention shows excellent smokability and high oxygen gas-barrier properties during storage and is therefore useful for long-time preservation of smoked foodstuffs packages. It exhibits excellent smokability and oxygen gas-barrier properties in its use for packaging of the foodstuffs susceptible to oxygen such as ham, sausage, bacon, meat, cheese and the like, and allows long-time storage of these foodstuffs without conducting secondary packaging on the smoked packages. It is particularly surprising that these good results can be obtained when the resin component consists of or comprises polyamide resins of low water absorptivity such as nylon II and I2, since these have previously been considered unsuitable for use as smokable packaging films.

The following are some examples of the invention.

Examples I - 5

By using a melt extruder having a cricular die, the mixtures of the polymer components and additives shown in Table 2 were extruded into a tubular form and worked into stretched tubular films of 4O to 5O μm in thickness and 7O mm in folded width by the conventional inflation method.

The oxygen-permeability of the obtained films at 3O°C and 6O% RH was measured by using OX-TRAN Type IOO of Modern Control Co.Ltd. The results are shown in Table 3.

Each of the obtained tubular films was stuffed with about 200 g of pork sausage material composed of 50% by weight of pork, 20% by weight of fat, 6% by weight of starch, 2% by weight of common salt and 22% by weight of water, and both ends of the stuffed tubular film were clipped to obtain a package. Each of the thus obtained packages was dried under the conditions of 50°C and I0-30% RH for I5 minutes and then smoked under the conditions of 60°C and 40-60% RH for 90 minutes in a smoke chamber and then subjected to a steam-heating treatment at 75°C for 60 minutes, and the effect of smoking on each package was determined by a sensory test (panel test).

In the sensory test (panel test), the smoking effect was evaluated as follows:

0: No smokability was admitted. (No smoking effect).
I: Smokability was admitted slightly.
2: Smokability was admitted evidently.
3: Smokability was admitted strongly.
4: Smokability was admitted very strongly.

The results are shown in Table 3.

COMPARATIVE EXAMPLES I and 2

By the same method as used in Example I, there were obtained the stretched tubular films of 40 μm in thickness and 70 mm in folded width from a mixture of nylon I2 and ethylene-vinyl alcohol copolymer (Comparative Example I) and a mixture of copolymer of a monomer of nylon 6 and a monomer of nylon 66, ethylene-vinyl alcohol copolymer and low-density polyethylene (Comparative Example 2).

The oxygen-permeability of the obtained films at 30°C and 60% RH was as shown in Table 3.

The sensory test was also conducted to determine the smoking effect on the pork sausages packaged with these films and treated in the same way as in Example I, the results being shown in Table 3.

EXAMPLES 6 - 8

By the same method as used in Example I, the mixtures of polymer blends and additives shown in Table 2 were extruded into a tubular form, thereby obtaining the non-stretched tubular films of 40-50 μm in thickness and 70 mm in folded width.

The oxygen-permeability of the obtained films at 30°C and 60% RH is shown in Table 3.

The results of the sensory test for smoking effect on the pork sausage packages obtained in the same way as in Example I are also shown in Table 3.

COMPARATIVE EXAMPLE 3

A non-stretched tubular film of nylon 6 having thickness of 40 µm and a folded width of 70 mm was obtained by the same method as in Example 6.

The oxygen-permeability of this film at 30°C and 60% RH is shown in Table 3.

The results of the sensory test on smokability of the pork sausage package obtained by using this film according to the method of Example I are also shown in Table 3.

Table 2

	Polymer		Additive	Mixing ratio (^{polymer}/additive)	Type of film (thickness)
	Components	Mixing ratio			
Example 1	Nylon 6	-	Polyoxyethylene sorbitan monooleate	95/5	Stretched film (40 µm)
Example 2	Nylon 12	-	Glycerin	90/10	Stretched film (50 µm)
Example 3	Nylon 6-10	-	Monoglyceride stearate	95/5	Stretched film (40 µm)
Example 4	Nylon 12 and EVAL*1)	50/50	Glycerin	95/5	Stretched film (40 µm)
Example 5	Nylon 6 and nylon 6-6 copolymer*2), EVAL and LDPE*3)	60/30/10	Glycerin	95/5	Stretched film (40 µm)
Example 6	Nylon 6	-	Glycerin	95/5	Non-stretched film (40 µm)

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	Polymer		Additive	Mixing ratio (polymer/additive)	Type of film (thickness)
	Components	Mixing ratio			
Example 7	Nylon 12	-	Polyoxyethylene sorbitan monooleate	88/12	Non-stretched film (50 μm)
Example 8	Nylon 12 and EVAL	50/50	Glycerin	95/5	Non-stretched film (40 μm)
Comp. Example 1	Nylon 12 and EVAL	50/50	-	-	Stretched film (40 μm)
Comp. Example 2	Nylon 6 and nylon 6-6 copolymer, EVAL and LDPE	60/30/10	-	-	Stretched film (40 μm)
Comp. Example 3	Nylon 6	-	-	-	Non-stretched film (40 μm)

Notes: *1) Ethylene-vinyl alcohol copolymer.

*2) Copolymer of a monomer of nylon 6 and a monomer of nylon 6-6.

*3) Low-density polyethylene.

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Table 3

	Sensory test on smokability				Utilizability Evaluation	
	Taste	Smell	Oxygen-permeability ($cc/m^2 \cdot day \cdot atm$)		Smokability	Preservability
			Before smoking	After smoking		
Example1	3	3	940	80	A	A
Example2	2	2.5	1500	180	B	B
Example3	2	2	480	100	B	B
Example4	2	2.5	1150	40	B	A
Example5	2.5	3	980	50	A	A
Example6	3	3.5	1250	82	A	A
Example7	3	3	1650	190	A	B
Example8	2.5	3	1150	60	A	A
Comp. Example1	1	1	40	-	C	A
Comp. Example2	1.5	2	50	-	C	A
Comp. Example3	1.5	2	140	-	C	B

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Criteria for Utilizability Evaluation

(i) Smokability (panel test)

A: Smokability was admitted strongly.
B: Smokability was admitted fairly strongly. } (Utilizable)

C: Smokability was admitted.
D: No smokability was admitted. } (Not Utilizable)

(ii) Preservability (long-time)

A: Excellent
B: Good } (Utilizable)

C: Not too bad. (Unsatisfactory for practical use)

D: Bad. (Not Utilizable)

It is necessary for being utilizable that the package has a rating of B or better for both smokability and long-time preservability.

Also, the "utilizable" film should have an evaluation value of 2 or greater for both taste and smell in the sensory test on smokability.

Claims

1. A smokable food-packaging film formed of a composition comprising a polymer component comprising 30 to 100% by weight of a polyamide resin and 0 to 70% by weight of an olefin polymer, characterised in that the composition comprises 80 to 98% of the polymer component and 2 to 20% by weight of an additive which is compatible with the polymer component, is liquid at 70 to 95°C, and is soluble in water and/or oil.

2. A film according to claim 1, wherein the polyamide resin is nylon 6, nylon 7, nylon 8, nylon 11, nylon 12, nylon 6-6, nylon 6-10, a mixture thereof, or a copolymer of these monomeric compounds.

3. A film according to claim 1 or claim 2 wherein the polymer component comprises a blend of 30 to 95% polyamide resin with 70 to 5% olefin polymer which is preferably a polyolefin, an ionomer resin or a copolymer of an olefin with (meth) acrylic acid, alkyl (meth) acrylate, vinyl acetate or vinyl alcohol.

4. A film according to claim 1 in which the olefin is selected from polyethylene, polypropylene, ionomer resin, ethylene-vinyl acetate copolymer, ethylene-ethyl acrylate copolymer, ethylene-acrylic acid copolymer, ethylene-methyl acrylate copolymer, ethylene-methyl methacrylate copolymer, and ethylene-methacrylic acid copolymer and copolymers of vinyl alcohol with ethylene, propylene or butene-1.

5. A film according to any preceding claim in which the additive comprises a material selected from aliphatic alcohols, polyglycols, polyoxyethylene sorbitan fatty acid esters, polyhydric alcohol esters, aliphatic dibasic acid esters, polyvalent hydroxy-carboxylic acid esters, aliphatic acid esters and epoxy plasticisers.

6. A film according to any preceding claim in which the additive comprises glycerol, polyoxyethylene sorbitan monooleate or glycerol monostearate.

7. A film according to any preceding claim having a thickness of 15 to 100 μm.

8. A film according to any preceding claim in which th corresponding film form d from the component in the absence of the additive has an oxygen permeability of not more than 200, and preferably not more than 50, cc/m².day.atm.

9. A method in which a food product is packed, in a film according to any preceding claim and is then smoked by exposing the package at 40 to 80°C to smoke ingredients that permeate the film and is then subjected to steam treatment at 70 to 95°C.

10. A method according to claim 9 in which the oxygen permeability of the film after the steam treatment is not more than 200, and preferably not more than 50, cc/m².day.atm.

11. A smoked food package comprising a foodstuff packaged within a film characterised in that the film is a film according to any of claims 1 to 8.